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(54) Title: ALLOCATION OF AN S-CSCF TO A SUBSCRIBER
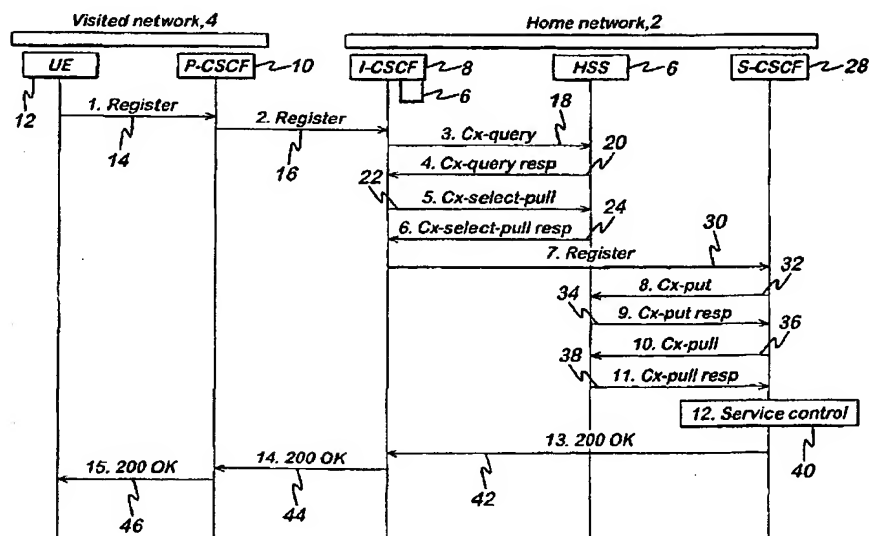
(57) Abstract: There is disclosed a technique in which there is allocated one of a plurality of serving call state control functions to a subscriber, the technique including: receiving load information from at least one serving call state control function; and determining a serving call state control function for the subscriber in dependence on the received load information, wherein the receiving step includes receiving the load information during subscriber registration in a signal received from a serving call state control function to an interrogating call state control function.

WO 03/075596 A1

ALLOCATION OF AN S-CSCF TO A SUBSCRIBER

Field of The Invention

5   The present invention relates to the registration of a subscriber in a wireless network. The invention is applicable to the registration of a subscriber in a home network, whether the subscriber is roaming or not. The invention particularly relates to a technique for allocating

10   a serving call state control function (S-CSCF) for such a subscriber based on the availability and load of the call state control functions located in the network.

Background to the Invention

15

As part of the registration of a mobile terminal in a home network, it is necessary for some resources to allocate a serving call state control function (S-CSCF). The S-CSCF is responsible for call routing, and provides a service control

20   interface for a user towards application servers. A S-CSCF may be associated with a plurality of mobile terminals, and consequently may support the routing for a plurality of calls. A S-CSCF may support various types of calls or sessions, such as voice over IP calls and multimedia

25   sessions, e.g. for gaming.

The resource that allocates the serving call state control function (S-CSCF) for a mobile terminal is an interrogating call state control function (I-CSCF), which includes the

30   functionality of a S-CSCF allocation. For a mobile terminal in a home network, such an I-CSCF in the home network selects the S-CSCF for the mobile.

It has been proposed that one parameter that will be used by
I-CSCF resource for selecting the serving call state control
function for a mobile terminal registering in a network is
5   the availability of serving call state control functions.

It is an object of the present invention to provide an
improved technique for allowing the availability and the
network load of a serving call state control function to be
10   taken into account when allocating resources to a mobile
terminal registering network.

Summary of the Invention

15   According to the present invention there is provided a
method of allocating one of a plurality of serving call
state control functions to a subscriber, the method
including: receiving load information from at least one
serving call state control function in a signalling message;
20   and determining a serving call state control function for
the subscriber in dependence on the received load
information.

The method may further include receiving load information
25   from a plurality of serving call state control functions.

The step of determining a serving call state control
function may be carried out by a network resource. The
network resource may be the interrogating call state control
30   function. The network resource may be a home subscriber
server.

The subscriber may be either located in a visited network or a home network and is registered in a home network.

The load information may indicate the actual current load of
5   the serving call state control function. The load information may indicate the availability of the call state control function. The load information may indicate a time period in which the serving call state control function cannot receive further subscriber registrations.
10

The method may further include a session between a serving call state control function and interrogating call state control function for transmitting the availability information. The method may further include sessions between
15   interrogating call state control function and a plurality of serving call state control functions. The method may further include transmitting an unavailability signal within the session from the serving call state control function to interrogating call state control function to indicate
20   unavailability of the serving call state control to receive subscriber registrations.

The method may further include transmitting an availability signal within the session from the serving call state
25   control function to the interrogating call state control function to indicate availability of the serving call state control function to receive subscriber registrations.

The method may further include transmitting a keep-alive
30   signal within the session from the serving call state control function to the interrogating call state control

function to indicate availability of the serving call state control function to receive subscriber registrations.

The signalling message may be related to subscriber registration. The signalling message may be related to a session between a serving call state control function and interrogating call state control function. The signalling message may be one of a 200 OK, INVITE, SUSPEND, or RESUME SIP Requests. The signalling message may be one of a Cx_Put, Cx_Put Resp, Cx_Pull, or a Cx_Pull Resp messages.

The serving call state control function may be selected on a session basis.

The subscriber may be located in a home network or a visited network, and the serving call state control function is located in the home network.

According to another aspect of the present invention there is provided a network element for allocating one of a plurality of serving call state control function means to a subscriber, the network including a home network comprising an interrogating call state control function means and a plurality of serving call state control function means; wherein the interrogating call state control function means receives load information from at least one of the serving call state control function means in a signalling message; and a broker associated with the network element determines a serving call state control function means for the subscriber in dependence on the received laod information.

The network element may be the interrogating call state
control function. The network element may be a home
subscriber server. The network may further include a visited
network, wherein the subscriber is connected in either the
5   visited network or the home network.

The interrogating call state control function means may
receive load information from a plurality of serving call
state control functions.
10

The load information may indicate the availability of a call
state control function. The signalling message may be
related to subscriber registration.

15   The network element may further include a session between a
serving call state control function for transmitting for
transmitting the availability information.

The signalling message may be related to a session between a
20   serving call state control function and interrogating call
state control function.

The signalling message may be one of a 200 OK, INVITE,
SUSPEND, or RESUME SIP Requests. The signalling message may
25   be one of a Cx_Put, Cx_Put Resp, Cx_Pull, or a Cx_Pull Resp
messages.

In a still further aspect the present invention provides a
mobile wireless communications system including a home
30   network, wherein the home network includes a network element
for allocating one of a plurality of serving call state
control function means provided in the home network to a

subscriber, the home network further comprising an
interrogating call state control function means; wherein the
interrogating call state control function means receives
load information from at least one of the serving call state
5   control function means; and a broker associated with the
network element determines a serving call state control
function means for the subscriber in dependence on the
received load information.

10 The mobile wireless communication system may further include
a visited network, wherein the subscriber is connected in
either the visited network or the home network.

Brief Description of the Figures

15

The invention will now be described by way of example with
reference to the accompanying Figures, in which:
Figure 1 shows a basic topology of a home network and a
visited network;
20 Figure 2 shows the stages of registration of a subscriber in
the visited network of Figure 1; and
Figure 3 shows the continuation of the subscriber
registration in which S-CSCF status information is provided
for dynamic S-CSCF allocation in accordance with the
25 invention.

Description of Preferred Embodiments

It will be understood that in the following description the
30 present invention is described with reference to particular
non-limiting examples from which the invention can be best

understood. The invention, however, is not limited to such examples.

With reference to Figure 1, there is described the network
5   elements for initial registration of a subscriber located in a visited network.

Referring to Figure 1 there is illustrated a home network (HN) 2 and a visited network (VN) 4. The home network 2
10   includes a home subscriber server (HSS) 6 and an interrogating call state control function (I-CSCF) 8. The home network also includes serving call state control functions (S-CSCFs), two of which are represented in Figure 1 by reference numerals 28 and 29. The visited network 4
15   includes a proxy call state control function (P-CSCF) 10 and a user equipment (UE) 12 associated with a subscriber.

In the example of Figure 1, the UE 12 is associated with the home network 2 and is normally connected in the home network
20   2. The UE is a roaming UE and has consequently roamed into the visited network 4. In accordance with known techniques, it is therefore necessary for the UE 12 to register with the home network 4.

25   Referring to Figure 2, there is illustrated the implementation of a technique for the initial registration of the UE 12 located in the visited network 4. It is assumed that radio bearers are already established for signalling, and a mechanism exists for the first message of
30   the registration procedure to be forwarded from the UE 12 to the P-CSCF 10 in accordance with known techniques.

After the UE 12 has obtained its signalling channel through
the access network (i.e. the visited network), registration
can be performed. To initiate registration, the UE 12 sends
a register signal, as identified by arrow 14, to the P-CSCF
5   10 in the visited network. The register information flow
sent by the UE 12 includes its subscriber identity and the
domain name of its home network 2.

Upon receipt of the register information flow, the P-CSCF 10
10   examines the home domain name to identify the entry point
into the home network 2. The entry point into the home
network 2 is through the I-CSCF 8. The P-CSCF 10 then sends
the register information flow to the I-CSCF 8 of the home
network as indicated by the arrow 16.
15

The register information flow sent from the P-CSCF 10
includes the P-CSCF "name" in a contact header, the
subscriber identity (i.e. the mobile terminal's identity),
and the subscriber contact name. A name-address resolution
20   mechanism is utilised by the P-CSCF 10 in order to determine
the address of the home network from the home domain name
provided by the mobile terminal 12.

When the I-CSCF 8 receives the registration information flow
25   from the P-CSCF 10, it examines the subscriber identity and
the home domain name, and employs the services of a name-
address resolution mechanism to determine the HSS address to
contact.

30   The I-CSCF sends a query information flow, as represented by
arrow 18, to the HSS. The query information flow includes
the P-CSCF name, the user terminal's subscriber identity,

and the home domain name. The P-CSCF name is the contact name that the operator of the home network uses for future contact to that P-CSCF.

5   The HSS 6 checks whether the user is already registered with the home network. In accordance with known techniques, the HSS 6 then determines whether the user is allowed to register in that visited network.

10   The HSS sends a query response as indicated by arrow 20, to the I-CSCF 8. At this stage it is assumed that the authentication of the mobile terminal has been completed. The I-CSCF sends a select-pull signal, as represented by arrow 22, to the HSS 6. The select-pull signal includes the
15   subscriber identity, and requests information from the HSS 6 relating to the required serving call state control function capabilities for the mobile terminal. The required serving call state control function capabilities are used to select an appropriate call state control function at a later step
20   in the registration cycle.

Responsive to the select-pull signal from the I-CSCF 8, the HSS 6 sends a select-pull response signal, as represented by arrow 24, to the I-CSCF 8. The select-pull response signal
25   details the required serving call state control function capabilities. The HSS provides information as to the required serving call state control functions in accordance with the mobile terminal's subscription information, held by the HSS 6 in the subscriber's home network.
30   The I-CSCF 8, including the S-CSCF allocation function as represented by block 26 in Figure 2, determines the name of an appropriate S-CSCF in the home network 2. The I-CSCF 8

determines, in this example, the selection of S-CSCF 28. The I-CSCF, using the name of the S-CSCF, determines the address of the S-CSCF 28 through a name-address resolution mechanism, and then sends the register information flow to

5 the selected S-CSCF 28 as represented by arrow 30. The register information flow includes the P-CSCF "name" in the contact header, and the user terminal subscriber identity and contact name.

10 The S-CSCF 28 sends a put signal, as represented by arrow 32, to the HSS 6. The put signal includes the subscriber identity of S-CSCF 28. This effectively registers the S-CSCF 28 as the serving call state control function for the UE 12 in the home network, so that the HSS can direct the

15 call connections appropriately. The HSS stores the S-CSCF 28 name for the subscriber.

The HSS 6 sends a put response signal as represented by arrow 34, to the S-CSCF 28 to acknowledge receipt of the put

20 signal.

On receipt of the put response information flow from the HSS 6, the S-CSCF 28 sends a pull information arrow 36, including the subscriber identity, to the HSS in order to

25 download the subscriber profile to the HSS 6 to the S-CSCF 28. The S-CSCF 28 stores the P-CSCF name as supplied by the visited network. This represents the name to which the home network forwards the subsequent terminating session signalling for the UE 12.

30

The HSS 6 returns an information flow pull response signal, as represented by arrow 38, to the S-CSCF 28. The pull

response signal includes the subscriber profile. The S-CSCF
28 then stores the subscriber profile for that indicated
user. The S-CSCF may perform whatever service control
procedures are appropriate, as indicated by block 40. The S-
5   CSCF 28 then returns a 200 OK information flow as
represented by arrow 42, to the I-CSCF 8. The 200 OK
information flow is well known in the art, and includes the
serving network contact name (in this case the home network
2) and the S-CSCF 28 name.

10

As represented by arrow 44, the I-CSCF then sends the
information flow 200 OK to the P-CSCF 10. The I-CSCF
releases all registration information after sending the
information flow 200 OK. The P-CSCF 10 stores the serving
15 network contact name, and sends the information flow 200 OK
to the mobile terminal as represented by arrow 46. The
registration process is then complete. The completion of the
registration process, including the format of the 200 OK
signals transmitted to complete such, is well known in the
20 art.

In accordance with the present invention, as part of its
registration process, the selected serving call state
control function 30 provides the S-CSCF allocation function
25 26 with details as to its current load status. That is, on
completing the registration process with the HSS 6, the
serving call state control function 28 forwards to the
interrogating call state control function 8 details as to
its current load on signal 200 OK 42.

30

This information is then used by the interrogating call
state control function 8 when determining the allocation of

a serving call state control function for the registration
of future subscribers.

The techniques by which a serving call state control
5   function may determine its current load are well known. The
load status of a serving call state control function can be
formed from a variety of parameters. For example, the load
may be determined based on the number of active calls
currently handled by the S-CSCF or the number of subscribers
10 currently registered with the S-CSCF. Each S-CSCF may
provide the I-CSCF with a load figure based on predetermined
levels of capacity for the S-CSCF. In providing the I-CSCF
with information concerning its load, the S-CSCF may simply
provide the I-CSCF with a figure indicating the current
15 percentage of its maximum capacity which is currently being
utilised.

In this way, the I-CSCF can use the current load of each S-
CSCF function to spread the load, such that S-CSCFs with low
20 loading are utilised. The I-CSCF is preferably provided with
an algorithm for determining the selection of the S-CSCF
based on the current load of the various S-CSCFs. The
algorithm may be very simple. For example, if each S-CSCF
provides the I-CSCF with a figure indicating the percentage
25 of its resources currently being utilised, then the I-CSCF
may simply select the S-CSCF with the lowest percentage.

However, more practically the allocation of the S-CSCF will
additionally be determined based on further parameters.
30 These further parameters may include a comparison of the
services supported by the S-CSCF, and the services the
subscriber requires. Other possible criteria for selecting

the S-CSCF will be apparent to one familiar with the art. The implementation of an appropriate algorithm will be well within the scope of a skilled person, given the desired selection criteria.

5

The load information is preferably transmitted from the serving call state control function to the interrogating call state control function by making an extension to the session initiation protocol (SIP) used for performing the registration in known techniques. In this way the status information is included in the signals transmitted with arrow 42 of Figure 2. Responsive to such signals the resource functionality provided in the interrogating call state control function updates status information and removes the status from the 200 OK message before further sending it on to the proxy call state control function.

The invention has been described herein with reference to a particularly preferred embodiment in which the S-CSCF allocation functionality 26 is provided by the interrogating call state control function. However the invention is not limited to this functionality being provided by the I-CSCF. This resource broker functionality, which allocates call state control function resource, can in fact be co-located with any network element. For example, the functionality may be co-located with the home subscriber server 6 of the home network 2. In such a scenario, during the profile downloading from the HSS 6, as illustrated by the arrows 32 to 38 in Figure 2, the S-CSCF would inform the HSS of its status including its load situation.

It should also be noted that the S-CSCF allocation functionality may be provided in a separate physical entity rather than as part of the functionality of another network element.

5

The element which provides the S-CSCF allocation functionality may be considered to be a resource broker.

The serving call state control function does not have to

10 update its status in every profile downloading. It may be required only to update its status in some periodic time frame. In overload situations the serving call status control function may be required to update its status more frequently.

15

In the above-described embodiments, the load information is provided to the I-CSCF by the S-CSCF providing information as to its current load status.

20 Alternatively, the S-CSCF may give an indication to the I-CSCF as to whether it can continue to receive new registrations. For example, if the S-CSCF is operating well within its capacity, it may send a signal to the I-CSCF that indicates that new registrations may continue to be sent,

25 and the I-CSCF will proceed on this basis.

However, if the S-CSCF determines that it is operating at or near its load capacity, it may send a signal to the I-CSCF asking for further registrations not to be sent. This may

30 take the form of new registrations not being sent for a default time period, e.g. twenty minutes. However, during that twenty minutes the load of the S-CSCF may reduce

earlier than the twenty minute period, and available
capacity in the S-CSCF is not efficiently utilised.

5   With reference to Figure 3, a preferred technique for
      signalling between a S-CSCF and an I-CSCF is described.
      Referring to Figure 3, it is assumed that an I-CSCF 100 is
      supporting three S-CSCFs, identified by reference numerals
      102, 104 and 106. For the purposes of the examples of Figure
      3, it is assumed that a session has already been established
10   for a set of subscribers using the I-CSCF 100, and the three
      S-CSCFs 102, 104 and 106 are supporting calls. As such, an
      SIP session is established between each of the S-CSCFs 102,
      104, 106 and the I-CSCF 100, as represented by signal
      connections 108, 110 and 112 as shown in Figure 3(a).

15

      In the preferred messaging, once an SIP session is
      established with an S-CSCF, the S-CSCF provides its
      supporting I-CSCF with an indication as to whether or not it
      is able to initiate new registrations. This is done by
20   issuing a control signal to the I-CSCF.

      Referring to Figure 3, it is assumed that the S-CSCF is
      operating with spare load capacity, and is therefore in a
      position to accept new registrations. As such, the S-CSCF
25.   102 transmits a RE-INVITE message 114 to the I-CSCF 100, re-
      inviting the I-CSCF to establish new registrations
      therewith. This can be considered to be a 'keep-alive'
      mechanism.

30   The RE-INVITE message 114 is transmitted periodically in
      accordance with SIP specifications.

On receipt of the RE-INVITE signal the I-CSCF 100 sends an acknowledgement signal 200 OK as represented b signal 116. The I-CSCF 100 then further includes the S-CSCF 102 in selecting the S-CSCF for a new registration.

5

Referring to Figure 3(c), it is assumed that the S-CSCF is operating with no spare load capacity, and is therefore unable to accept new registrations. As such the S-CSCF 102 transmits a SUSPEND message 118 to the I-CSCF, indicating that no further new registrations can be established with the S-CSCF 102.

10

On receipt of the SUSPEND signal the I-CSCF 100 sends an acknowledgement signal 200 OK as represented by signal 120. The I-CSCF 100 then does not include the S-CSCF 102 in selecting the S-CSCF for any new registration.

15

As illustrated by Figure 3(d), at some time thereafter the load on the S-CSCF 102 is reduced sufficiently to enable the S-CSCF to receive new registrations. As such, the S-CSCF 122 transmits a RESUME message 122 to the I-CSCF.

20

On receipt of the RESUME message the I-CSCF 100 sends an acknowledgement signal 200 OK as represented by signal 124. The I-CSCF 100 then further includes the S-CSCF 102 in selecting the S-CSCF for a new registration. The RESUME message is only ever sent after a HOLD message.

25

Thus according to the present invention an existing profile downloading protocol is used to provide a S-CSCF allocation

30

functionality in the network with an update on the status of call state control functions in the network.

Although the present invention has been described with reference to particular example communication exchanges and example network scenarios, it is not limited to any such examples. The scope of the present invention id determined by the appended claims, and one skilled in the art will appreciate the general applicability of the invention.

CLAIMS

1.   A method of allocating one of a plurality of serving
call state control functions to a subscriber, the method
5   including:
      receiving load information from at least one serving
call state control function in a signalling message; and
      determining a serving call state control function for
the   subscriber   in   dependence   on   the   received   load
10   information.

2.   The method of claim 1 further including receiving load
information from a plurality of serving call state control
functions.
15

3.   The method of claim 1 or claim 2 wherein the step of
determining   a   serving   call   state   control   functions   is
carried out by a network resource.

20   4.   The method of claim 3 wherein the network resource is
the interrogating call state control function.

5.   The method of claim 4 wherein the network resource is a
home subscriber server.
25

6.   The method of any one of claims 1 to 5 wherein the
subscriber is either located in a visited network or a home
network and is registered in a home network.

30   7.   The method of any one of claims 1 to 6 wherein the load
information indicates the actual current load of the serving
call state control function.

8.   The method of any one of claims 1 to 6 wherein the load information indicates the availability of the call state control function.

5

9.   The method of any one of claims 1 to 6 wherein the load information indicates a time period in which the serving call state control function cannot receive further subscriber registrations.

10

10.   The method of claim 1 further including a session between a serving call state control function and interrogating call state control function for transmitting the availability information.

15

11.   The method of claim 10 further including sessions between interrogating call state control function and . a plurality of serving call state control functions.

20   12.   The method of claim 10 further including transmitting an unavailability signal within the session from the serving call state control function to interrogating call state control function to indicate unavailability of the serving call state control to receive subscriber registrations.

25

13.   The method of claim 10 further including transmitting an availability signal within the session from the serving call state control function to the interrogating call state control function to indicate availability of the serving

30   call state control function to receive subscriber registrations.

14. The method of claim 10 further including transmitting a keep-alive signal within the session from the serving call state control function to the interrogating call state control function to indicate availability of the serving

5   call state control function to receive subscriber registrations.

15. The method according to claims 1 to 9 wherein the signalling message is related to subscriber registration.

10

16. The method according to claims 10 to 14 wherein the signalling message is related to a session between a serving call state control function and interrogating call state control function.

15

17. The method according to claims 15 and 16 wherein the signalling message is one of a 200 OK, INVITE, SUSPEND, or RESUME SIP Requests.

20   18. The method according to claim 15 wherein the signalling message is one of a Cx_Put, Cx_Put Resp, Cx_Pull, or a Cx_Pull Resp messages.

19. The method of any one of claims 1 to 18 in which the

25   serving call state control function is selected on a session basis.

20. A method according to any preceding claim in which the subscriber is located in a home network or a visited

30   network, and the serving call state control function is located in the home network.

21. A network element for allocating one of a plurality of serving call state control function means to a subscriber,

5 the network including a home network comprising an interrogating call state control function means and a plurality of serving call state control function means; wherein the interrogating call state control function means receives load information from at least one of the serving

10 call state control function means in a signalling message; and a broker associated with the network element determines a serving call state control function, means for the subscriber in dependence on the received laod information.

15 22. A network element according to claim 19, wherein the network element is the interrogating call state control function.

23. A network element according to claim 20, wherein the

20 network element is a home subscriber server.

24. A network element according to any one of claims 19 to 21, wherein the network further includes a visited network, wherein the subscriber is connected in either the visited

25 network or the home network.

25. A network element according to any one of claims 19 to 22 wherein the interrogating call state control function means receives load information from a plurality of serving

30 call state control functions.

26. A network element according to any one of claims 21 to wherein the load information indicates the availability of a call state control function.

5   27. A network element according to claims 21 to 26 wherein the signalling message is related to subscriber registration.

28. A network element according to any one of claims 21 to
10   27 further including a session between a serving call state control function for transmitting for transmitting the availability information.

29. A network element according to claims 28 wherein the
15   signalling message is related to a session between a serving call state control function and interrogating call state control function.

30. A network element according to claim 28 or 29 wherein
20   the signalling message is one of a 200 OK, INVITE, SUSPEND, or RESUME SIP Requests.

31. The method according to claim 27 wherein the signalling message is one of a Cx_Put, Cx_Put Resp, Cx_Pull, or a
25   Cx_Pull Resp messages.

32. A mobile wireless communications system including a home network, wherein the home network includes a network element for allocating one of a plurality of serving call
30   state control function means provided in the home network to a subscriber, the home network further comprising an interrogating call state control function means; wherein the

interrogating call state control function means receives load information from at least one of the serving call state control function means; and a broker associated with the network element determines a serving call state control

5   function means for the subscriber in dependence on the received load information.

33. A mobile wireless communication system according to claim 32 further including a visited network, wherein the

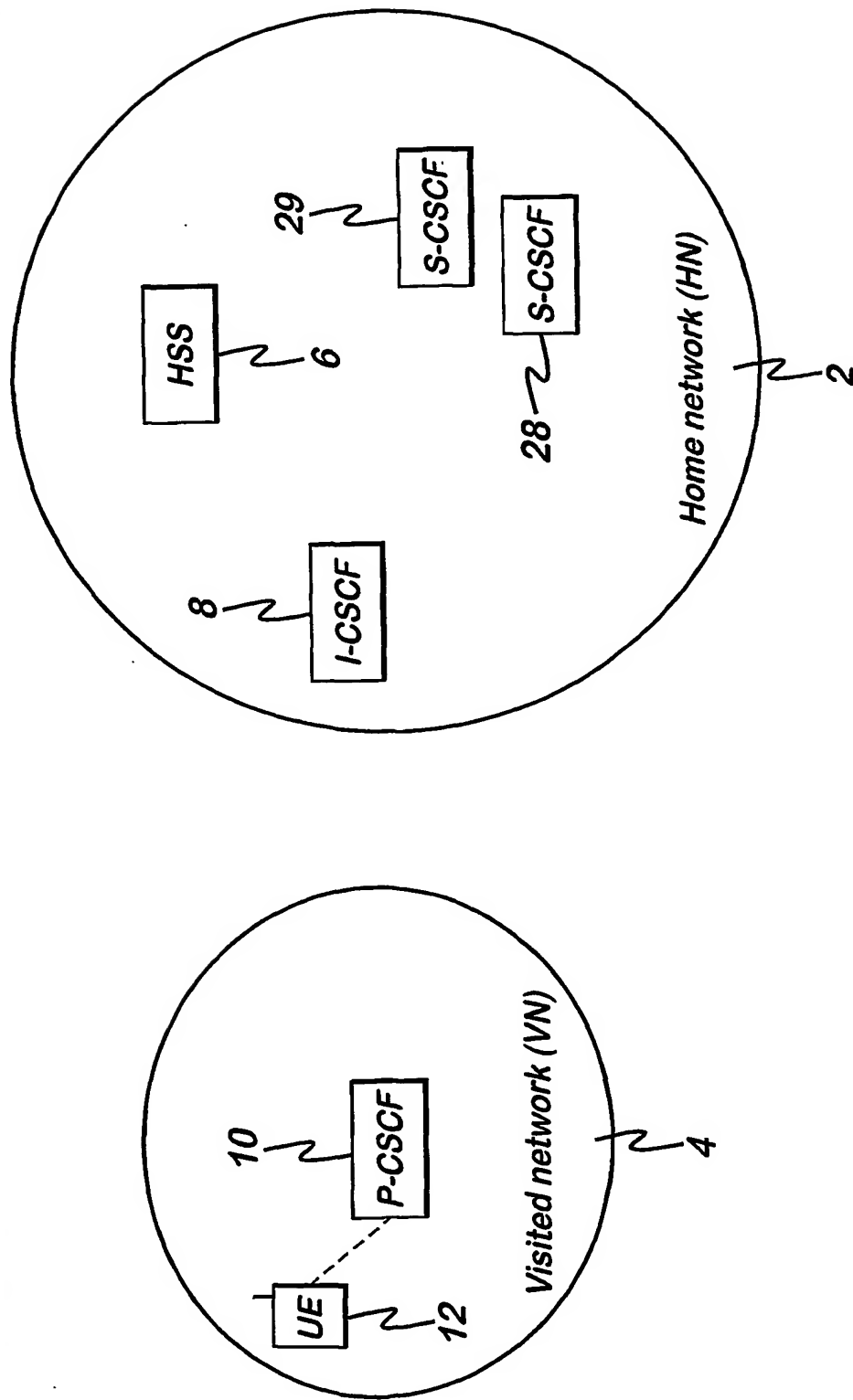10 subscriber is connected in either the visited network or the home network.

Fig. 1

Fig. 2

Home network, 2

Visited network, 4

S-CSCF ~28

HSS ~6

I-CSCF ~8
~6

P-CSCF ~10

UE
~12

1. Register ~14

2. Register ~16

3. Cx-query ~18

4. Cx-query resp ~20

~22

5. Cx-select-pull ~24

6. Cx-select-pull resp

7. Register

8. Cx-put ~30

~32

9. Cx-put resp ~34

10. Cx-pull ~36

11. Cx-pull resp ~38

12. Service control ~40

13. 200 OK ~42

14. 200 OK ~44

15. 200 OK ~46
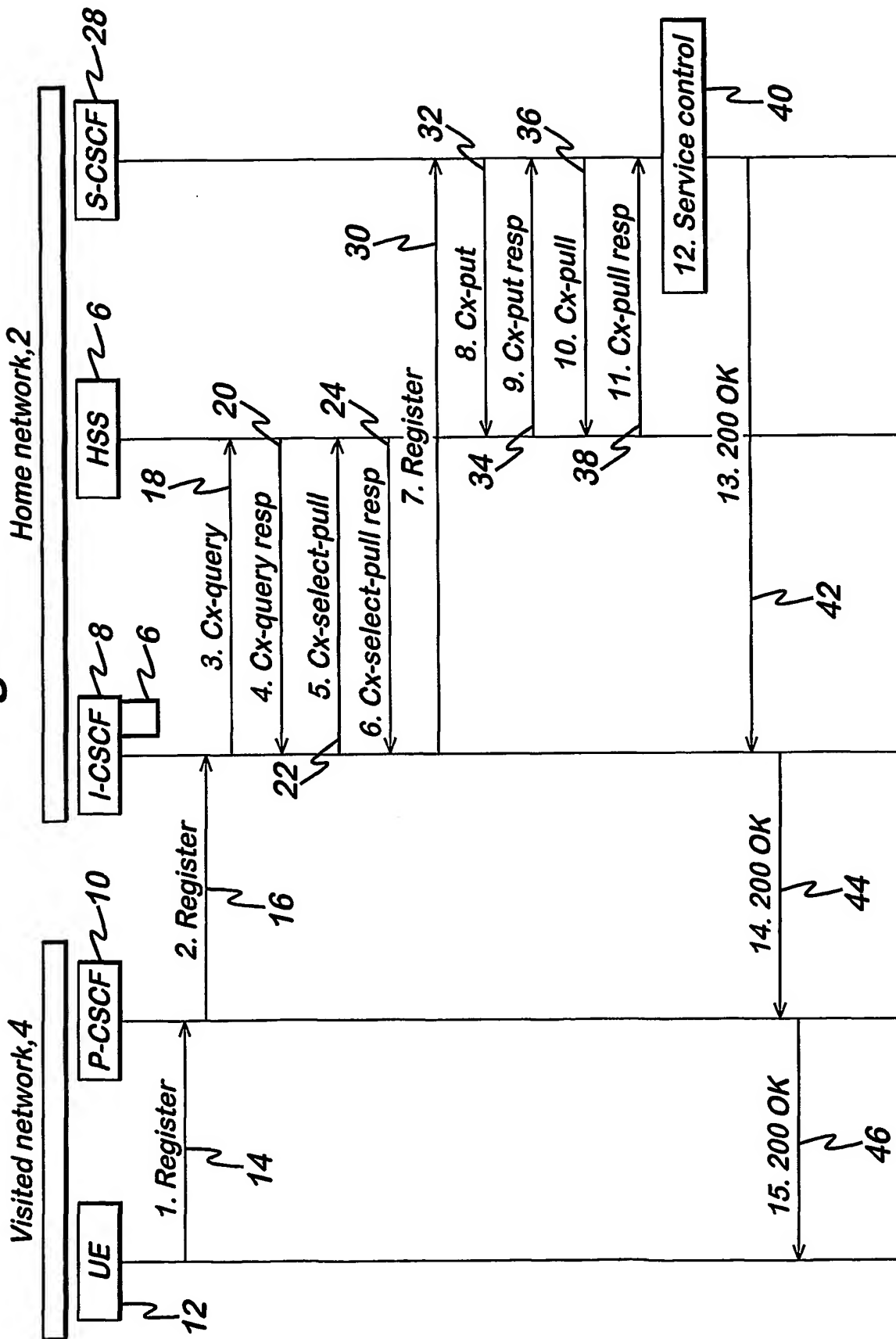
Fig. 3
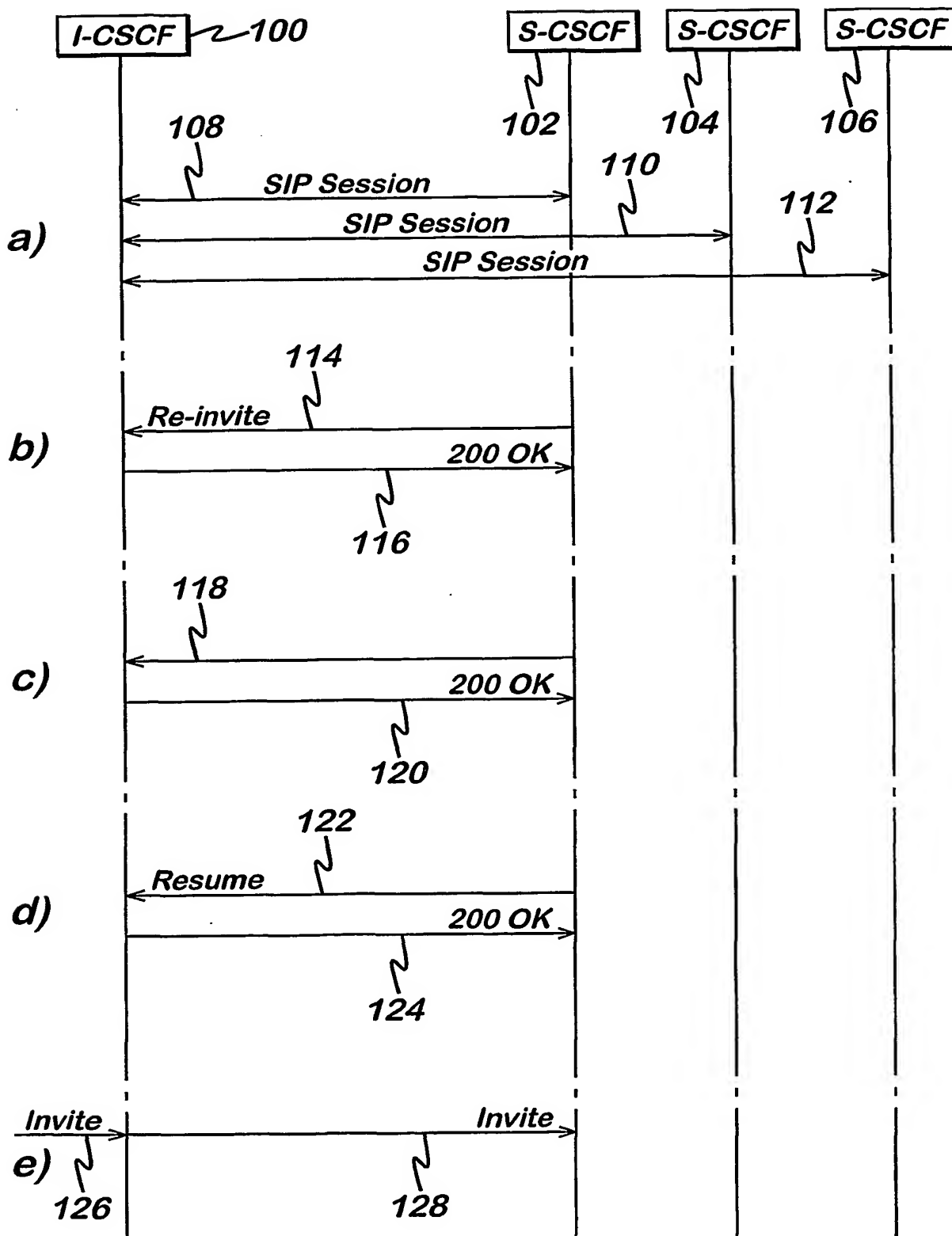
INTERNATIONAL SEARCH REPORT

International application No.	
PCT/IB 03/01280	

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/38
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 0186968 A1 (NOKIA NETWORKS OY), 15 November 2001 (15.11.01), page 10, line 35 – page 11, line 9	1-13,15,16, 19-29,32,33
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A	WO 0209365 A1 (NOKIA CORPORATION), 31 January 2002 (31.01.02), figure 1, abstract	1-33
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☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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